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The Moreton Bay and Port Jackson Figs for Hawaiian Forests.

There is every reason to believe that these two remarkable trees from Australia may be relied upon to serve as major components of the new forests which we must build on our denuded watersheds. They are trees of fine shape, attain large dimensions and show ability to grow under a very wide range of conditions. There are two fine large trees of the Moreton Bay fig in Honolulu and a vigorous young tree in Honomu. There is a large specimen of the Port Jackson fig on the old Tantalus Road and five young fruiting trees in the grounds of the U. S. Experiment Station. Both of these trees have been planted extensively in California and have proven hardy as far north as San Francisco, where they survive light frosts. We may therefore expect them to do well in Hawaii at all elevations from sea level up to 6000 feet. The figs produced by these trees are very attractive to fruit-eating birds, which disseminate the seeds over all areas which they chance to visit.

If we plant groves of these trees at intervals on our watersheds we can depend upon the mynah birds to spread them for us as soon as they begin to produce fruit. During the coming winter we shall have upwards of 250,000 seedling trees of these two figs of suitable size for planting out. If we can get these well distributed over the Islands we shall have laid the foundation for the gradual rehabilitation of our forests through natural agencies. We would suggest that each plantation set out several thousand of these trees on lands in or adjacent to their forest areas. These particular figs make excellent shade trees for streets and parks and may be planted to advantage along roads and about camps.

No Short Course This Year.

The delay in the harvesting season makes it inadvisable to hold a short course for plantation men this year. This conclusion is reached after writing the plantations and learning that a sufficiently large attendance cannot be expected. The previous courses have been entirely successful and the plan of holding future courses is not being abandoned. The 1921 course is omitted, all hands being needed on the job to get off the crop.

Hilling in the Hilo District.

An experiment to determine the value of hilling has been harvested at the Hilo Sugar Company. In this test all plots received regular plantation cultivation, except that hilling was omitted in half the plots.

The not hilled plots produced 0.63 ton of sugar more per acre than did the plots which were hilled. Similar results were obtained from the crop harvested two years ago.

These returns are a striking contrast to those reported from McBryde Sugar Co., where hilling showed definite gains.

Cane Varieties in Pioneer Mill Company.

A variety experiment has recently been harvested at the Pioneer Mill Company, in which H 33, H 109, H 146, D 1135, Lahaina, and Striped Mexican were compared on the upper lands of the plantation. The cane was two years old when harvested. Having been planted in July, 1919, it experienced the water shortage that has prevailed.

In this case the yield of D 1135 exceeded that of H 109. Lahaina and Striped Mexican were somewhat lower than H 109, and H 33 was still lower. H 146 was a failure under the conditions of the test.

Nitrates.

In comparing the loss through leaching of nitrate of soda and nitrate of ammonia, little difference is found in the behavior of these two salts in cylinders holding four-foot columns of soil.

The fertilizing salts were applied at the maximum rate which is used upon the irrigated plantations, that is, 1000 pounds of sodium nitrate per acre, carrying about 155 pounds of nitrogen. First there was tried a two and a half inch irrigation upon the cylinders. With such an application about one-third of the irrigation water escaped as drainage. In two such irrigations less than 5% of the added nitrogen was carried out of the soil. With an irrigation of 5½ inches the loss was slightly higher, but with most of the soils it did not exceed 10%.

Work with these cylinders is being continued, but the results so far obtained show the high absorptive power of the Hawaiian soils. This also explains the reason why such excellent results are obtained with sodium nitrate in the rainy districts. There will be a considerable variation in the amount of nitrates retained by different soils, but it is believed that the soils used are sufficiently typical so that no fear is felt that the greater part of an application of nitrate of soda will be washed out by a heavy rain soon after its application.

Biological Control of Destructive Insects.

The following letter in "Science," August 5, 1921, is of interest:

To the Editor of Science: Control of destructive insects by the introduction of their natural enemies has become an important technique during the last generation. But if competent observers are to be trusted, the southern Arabs employed the same method more than 150 years ago, in the culture of the date-palm.

In his "Relation d'un Voyage dans l'Yemen" (Paris, 1880, p. 155), P.-E. Botta says:

> I was able to verify the singular fact previously observed by Forskål, that the date-palms in Yemen are attacked by a species of ant which would cause them to perish, if each year the growers did not bring from the mountains and fasten in the tops of the palms branches of a tree that I did not recognize, which contain the nests of another species of ant which destroys that of the date-palm.

P. Forskål was the naturalist of C. Niebuhr's expedition; his work was published posthumously in 1775. I have not seen his account to which Botta refers.

It would be interesting to know whether the history of economic entomology furnishes any earlier record of the "biological method" of pest control.—*Paul Popenoe, Therman, Calif., April* 24, 1921.

[F. M.]

Improvement of Sugar Cane Through Bud Selection.

A Report on the Work Since May 1, 1921.

By Wm. W. G. Moir.

Following the work on Oahu under the direction of Mr. A. D. Shamel, selection was carried on at the following places: Maui Agricultural Company, Wailuku Sugar Company, Hilo Sugar Company, Paauhau Sugar Plantation Company, and Onomea Sugar Company. A brief report on the whole work at each place follows.

Maui Agricultural Company.

Experiments were laid out at Hamakuapoko in 1920 by Mr. E. L. Caum and the writer, covering a number of points under consideration in the selection project of the Experiment Station, such as the inherent qualities of single stools, single eyes, irregular- and uniform-stalked stools, and the spacing of seed. It might be of interest to note here that the area used for these plantings was a fallowed section of a field that was badly infested with nut-grass, and that no

fertilizer was used throughout the crop. The results obtained should be all the more interesting on this account.

The first experiment, and probably the most valuable, was a detailed study and planting of some forty single-eye stools of H 109, started in 1919 by Mr. D. Sloggett, then overseer for the Hamakuapoko section. These single-eye stools were the one-year crop from well-developed eyes selected from large stalks in the field, started in pots and later set out in the field, spaced one foot apart. The extreme variations in size of stalk, number of stalks per eye, strength of growth and color (types) were immediately apparent. In number of stalks alone the variation ranged from 0 to 12, while in strength and color one easily could be tempted to divide them into separate varieties instead of considering them as all of the same variety. All forty of the single-eye progenies were studied and the data recorded. Later they were cut up for seed and each one planted as a separate progeny. Among these there stood out two strong types, one of which was represented by two large stools of 10 and 12 stalks, respectively, that were well ahead of the others.

The 1921 crop from these progenies gave even more marked results, for the yield from the single-stalk stools was below the plantation average, while that from the strong types mentioned above was more than double the plantation average. The difference in strength of stalk, uniformity of stools, inherent power of heavy production and color type, and the marked superiority of some progenies over others were so apparent that even the laborers commented upon them. For instance, in tonnage alone for the ten-months crop the yield per progeny varied from 20 to 120 tons of cane per acre, the latter figure being that for either of the two heavy strains mentioned above.

The results obtained from the other experiments at Hamakuapoko pointed toward improvement in yield through selection. In the study of the inherent qualities of irregular and uniform stools it was found that in the majority of cases like produced like, but several remarkable exceptions were noted and kept for future study.

The most surprising point in the study of these progenies was that all those selected for further study fell within two distinct types of H 109, easily distinguished from each other, yet closely related. These two types, one large-eyed, erect and orange in color, and the other large-eyed, semi-erect and white, are by far the most desirable. They are both very common types on Maui. The difference between these types is so marked that when they are cut up into seed pieces and mixed together any laborer could separate them correctly, and he would probably say that one of them was not H 109. In a few cases single-eye plantings were found giving rise to both types. These cases were recorded and the seed planted separately.

On August 18, 1921, I visited this area and was most gratified to see the excellent stand of cane. Progeny 1 (the 10-stalk stool) and progeny 2 (the 12-stalk stool) are exceptionally good and show their inherent qualities of heavy production, while progeny 50, where two types arose from a single eye, showed its inherent ability to reproduce each type according to the seed planted. The orange type was erect and stooling slowly (typical H 109), while the white type was spread out like Lahaina, with secondary and tertiary shoots as large as the

primary—a difference as marked as the difference in growth between Lahaina and D 1135.

The Lahaina cane planted last year became infected with Lahaina disease, but one stool of 12 stalks from a single-eye planting seemed to be in the best of health. This stool was retained and planted out. The new crop seems to be maintaining the superiority of the parent stool, with its possibilities of overcoming the disease.

Ratoons are being cared for along with the plant crop, and our next year's figures and observations on these two crops will probably be the most valuable data we will have, due to the isolation of types.

Wailuku Sugar Company.

A total of 101 progenies was planted in Field 98 this year. They include 89 of H 109, 8 of Opukea, 2 of Striped Mexican, and 1 each of Lahaina and Badila. Most of these were selected from a mother-field planted last year, but as this mother field was planted close and the seed from different stools mixed, a new start on progeny work had to be made. In these progenies we have many excellent stools with as many as 25 or 30 stalks per seed piece. The stand in the newly planted area is one of the finest to be seen and will require no replanting. Here again, as at Hamakuapoko, color types became very apparent, but due to exposure to the sun and to other environmental factors, type characteristics of this nature were obliterated.

Hilo Sugar Company.

This year, with the aid of Mr. Austin of the Hilo Sugar Company, a large progeny test area has been planted in Field 4. The first stools selected were taken from the general selected area of last year, and then the selection was continued in a one-year-old plant field. Nearly 1000 stools were so obtained and planted. The remaining canes in the general selected area were used for seed to plant an adjoining block to determine the value of mass selection.

Paauhau Sugar Plantation Company.

Mr. Poole, of the Paauhau Sugar Plantation Company, has been conducting selection work at Paauhau and has secured a large planting of selected D 1135 and Yellow Caledonia, and will later conduct selection work in H 109 and several promising seedlings. The selection work in D 1135 and Yellow Caledonia was done in two-year cane, the whole stalk being cut for seed, and the seed pieces being spaced three feet apart in the rows. All seed was soaked for several hours.

Onomea Sugar Company.

Individual plant and progeny performance record data have been obtained on the progeny test area planted at Papaikou in 1920. The following table will show the striking increase of selected cane over the unselected:

Increase (unselected = 100%)

	Stalks per Seed Piece	Stalks per Foot of Row	Tons cane per Acre *
68 selected progenies	162%	129%	130%
22 best selected progenies	202%	169%	157%
3 very best selected progenies	228%	189%	184%

* Tonnage is figured on the weight of the entire stick, including the seed pieces later removed for planting.

A gain was also noted in circumference and length of stalk, strength and rapidity of growth, and in the smaller amount of seed required for planting. In this case 20% was saved on seed alone, and it is hoped that this gain may be increased still more. Stools that were selected from crowded positions in the field maintained their supremacy over those from open positions; strains with a tendency to tassel the first year were noted; and those recorded as recumbent types last year produced very poorly this year and showed their greater liability to damage by cultivation, illiau, and rats.

By the use of the data so obtained, the best progenies were selected, and this selection checked up very closely with a general appearance selection. The very best stools in the best progenies were then taken for seed and planted in the test area, while the remaining seed in each progeny was bunched for planting. Next year data on tonnage yield per progeny will be obtained from four sources —yield on the plant crop of the best stools, yield on the plant crop of the remainder of each progeny, yield on the ratoons of the best stools, and yield on the remainder of the ratoons. To make these figures comparable with those of the present crop the seed was planted the same—spaced only three inches.

Many additional progenies have been planted at Papaikou, including Yellow Caledonia, Big Ribbon, and Black Tanna, numbering 512 in all, several of which stood out as distinct types.

Summary of Observations.

Since Mr. Shamel's departure and the publication of the report of the year's progress, much additional data have been obtained to show the inherent superiority of some parent stools and their progeny over others. Some progenies that have been obtained will yield as much in one year as the plantation fields will average in two, and others have been kept for study that were so inferior that one had difficulty in obtaining seed to continue the progeny through another crop. Does not this fact alone demonstrate the importance and necessity of selection to maintain high yields?

Distinct strains, mostly color and growth types, have been isolated that are so distinctly superior that they stand out like new varieties of cane. Constant association with and close study of the varieties are necessary if one is to become familiar with the types and strains as they grow in the field under different environmental conditions. More time should be spent on study of the progenies than on their cutting and planting.

There are many minor points to be considered along with the selection of the cane, such as the cutting of the seed, hardness of the stalk and of the eyes, the use of lala seed, number of eyes on the seed piece, sharpness of the knife, and the method of handling the seed prior to planting. All of these must be considered, as they may materially affect the results.

Conclusions.

(1)—Good seed is a determining factor in the production of maximum crops of sugar cane.

(2)—Good seed may be obtained by selection of superior stools, thus eliminating the unproductive and weaker strains.

(3)—Like produces like.
(4)—Certain inherently good stools maintain their superiority over others.
(5)—Types and strains exist and can be isolated.
(6)—Better and quicker germination of seed is obtained from superior parent plants.
(7)—More healthy stalks reach maturity and fewer dead shoots are found in selected progenies than in the ordinary run.
(8)—Better growth is maintained throughout the crop in selected canes.
(9)—Increased tonnage will result from proper selection.

But in all this work we must not overlook the value of seedling production, for in each variety that we have there is a strain that is the maximum yielding strain for that variety. The best strain of H 109 is probably better than the best strain of Lahaina, and there is no reason why we should not develop another seedling whose maximum will be higher than that of H 109. Our conditions here demand various constitutional varieties of cane, and these varieties are obtainable only through the growing of seedlings. These varieties having been established, then, by means of bud selection, we can isolate the superior strains. The seedling work and bud selection work go hand in hand—the first gives us our varieties of cane, and the second brings these varieties to their highest efficiency.

The Sugar Cane Beetle-Borer Parasite in Fiji.

Soon after the Tachinid parasite *(Ceromasia sphenophori)* of the beetle-borer was established in Hawaii, colonies were sent to Fiji, and for several years efforts were made to establish it, but apparently without any success, and at last all efforts were abandoned as hopeless.

Last year when working in the southeast portion of Fiji on the Rewa River, Mr. Pemberton found the parasite, and upon investigation it was discovered that about 30% of the beetle grubs were parasitized.

In a recent letter from Mr. Veitch, entomologist to the Colonial Sugar Refining Company, the following interesting paragraph occurs:

> "The Tachinid fly is now a very decided success on the Rewa, and this year borer at Nausori is almost a negligible quantity, a result that is very satisfactory after the bitter disappointment of previous years. . . . . . . In the establishment of the Tachinid parasite we now see substantial reward for all the money expended by the C. S. R., and in its success at Nausori Mill alone the saving effected is at the very least equal to ten times the annual expenditure on entomological research. For this we shall always be under a debt of gratitude to the H. S. P. A. for the excellent work done in discovering and introducing that parasite."

In the same letter is reported the first finding of *Placsius javanus,* a Histerid beetle introduced seven years ago from Java to Fiji to prey upon the banana-

borer, a beetle related to the cane-borer. It was considered that the colonies had died out, but the discovery of a specimen indicates that it has maintained itself for seven years, and it is possible that it will now increase gradually and be of economic importance. [F. M.]

Some Notes on Bud Selection of Sugar Cane.

In 1920 there was a cooperative investigation between A. D. Shamel and the men of this Station. A plan was arrived at, whereby we went through a field of cane ten to twelve months old, planted after the commercial fashion of Hawaii, and selected the stools of cane that showed in combination these points:

(a) More than the average number of stalks.
(b) Stalks of more than average size.
(c) A distinct uniformity as to the size and general character of the individual stalks.

These stools were cut and used as seed cane. Some of this work was done at Waipio. In order to avoid any gaps, only the seed cane in choice condition was employed in the planting. Some of the harder seed, thus discarded, was brought to Honolulu and planted in a small area at Makiki. This took place June 26, 1920. The cane that resulted was photographed August 23, 1921, after fourteen months' growth. The picture is shown herewith. The variety is H 109. In size, uniformity, and number of sticks this makes a very satisfactory appearance. Bear in mind that this is the product of the first crude selection. The yielding power of H 109 can be still further increased by singling out the best of the strains that compose the block of cane we have illustrated.[1]

From the plantings made in 1920 at Waipio a still further selection was made in April, 1921. Several progenies were planted at Makiki as single-eye cuttings. These were at first handled in pots and afterwards transplanted to the field and spaced at two-foot intervals. The best of the progenies so handled, No. 142, was planted alongside of the poorest, No. 15. (Not the poorest strain of H 109 to be found, merely the poorest of those which had in the beginning been selected as distinctly better than the run of the field.)

This cane in August was well stooled out, joints were beginning to show on a few stalks that were further advanced. There was visible a distinct difference between progeny 142 and progeny 15. No. 142 appeared to have greater uniformity. There were many good stools among No. 15, but there were also some poor ones. No. 142 showed no stools that were definitely poor.

We decided to record the difference between these two adjoining progenies by taking two rows of each and making detailed counts and measurements on 38 stools of each progeny.

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[1] Soil comparatively new, only in cane a few years; fertilization low, one application August 26, 1920, supplied 51 lbs. of nitrogen; another, March 21, 1921, supplied 54 lbs. of nitrogen; irrigation normal.

H 109 cane grown from seed cane of stools selected on the basis of size, number, and uniformity of sticks. Planted June 26, 1920. Photographed August 23, 1921.

The average number of shoots per stool was about the same; 16.2 in No. 142 and 16.3 in No. 15. In the case of No. 142 this varied from 12 to 22, while in No. 15 the variation took the much wider limits of 7 to 30.

The length of the primary shoots of No. 142 averaged 34.3 inches, when measured from the ground to the last visible dewlap;[2] No. 15, 28.2 inches.

It is problematical at this time as to how much detailed attention can be devoted to recording measurements and characteristics of individual cane plants. However, for the benefit of those who may become interested in this phase of the work we have listed in tabular form the biometric data secured on these seventy-two stools of cane, progenies 142 and 15, there being thirty-six stools of each.

There were a number of different types of cane stools noticed in these and other progenies of the same age. Two of these stool types are pictured in Fig. 2. A represents the so-called nest type, where the suckers branch out at the surface of the ground, forming thereby a nest-like appearance. B shows a stool of an entirely different character, the suckers branching off at a greater depth and being usually more sturdy and uniform. We are inclined to favor this type of stool and have termed it the standard type. The diagrams shown below the pictures indicate the number, size, and position of the shoots in each of these stools.

A number of stools of different forms will be followed and their comparative merits judged when they are mature.

We believe that as the work proceeds we will learn to tell much about the value of a strain of cane by the general conformation of the stools when but a few months old. If this proves to be the case it will expedite the work of selection.

H. P. A.
J. A. V.
Y. K.

DATA COMPARING TWO STRAINS OF H 109 AFTER FOUR MONTHS' GROWTH.

	Progeny No. 142	Progeny No. 15
Character of stooling	6 deep	10 deep
	16 medium	19 medium
	14 shallow	7 shallow
	36	36
Shape of stool	11 fan type	20 fan type
	13 nest type	9 nest type
	6 standard type	4 standard type
	6 nondescript	3 nondescript
	36	36

[2] For illustrated definition of this term see Record Vol. XXII, p. 297.

Fig. 2.—These two types of stools are found in selected H 109 cane planted from one-eye cuttings. The ''nest'' type shown at the right has shoots that branch off at the surface of the ground. In the ''standard'' type at the left the shoots are more deeply rooted. The diagrams below the pictures show the relative size, number, and position of the individual shoots.

Amount of purple on leaf sheaths	3 much	5 much
	25 medium	21 medium
	8 little	10 little
	36	36
General uniformity of shoots with primary stick	2 high	8 high
	18 medium	19 medium
	16 low	10 low
	36	36
General uniformity of sticks independently of primary stick	2 high	12 high
	27 medium	14 medium
	7 low	10 low
	36	36
Length of primary shoot	0......15″ to 20″	1......15″ to 20″
	0......20″ to 25″	9......20″ to 25″
	5......25″ to 30″	13......25″ to 30″
	16......30″ to 35″	11......30″ to 35″
	13......35″ to 40″	1......35″ to 40″
	1......40″ to 45″	1......40″ to 45″
	1......45″ to 50″	0......45″ to 50″
Diameter of primary shoot	1.... ¾″ to 1 ″	4.... ¾″ to 1 ″
	29....1 ″ to 1¼″	31....1 ″ to 1¼″
	6....1¼″ to 1½″	1....1½″ to 1½″
	36	36
Number of shoots of different lengths	33..... 0″ to 5″	33...... 0″ to 5″
	128..... 5″ to 10″	140...... 5″ to 10″
	231.....10″ to 15″	250......10″ to 15″
	82.....15″ to 20″	84......15″ to 20″
	51.....20″ to 25″	36......20″ to 25″
	21.....25″ to 30″	8......25″ to 30″
	2.....30″ to 35″	1......30″ to 35″
	548	552
Number of shoots of different diameters	38...0 ″ to ¼″	40....0 ″ to ¼″
	270... ¼″ to ½″	271.... ¼″ to ½″
	117... ½″ to ¾″	152.... ½″ to ¾″
	90... ¾″ to 1 ″	79.... ¾″ to 1 ″
	32...1 ″ to 1¼″	9....1 ″ to 1¼″
	1...1¼″ to 1½″	1....1¼″ to 1½″
Average length of shoots	13.11 inches	12.13 inches
Average diameter of shoots	.546 inches	.502 inches
Average volume of shoots of stool	47.01 cu. in.	39.02 cu. in.
Uniformity factor, 1 representing perfect uniformity: Length	.6798	.6964
Diameter	.7049	.6417

A Dust Insecticide Against Leafhoppers.

By H. T. Osborn.

Considerable attention has been devoted in the past several years in insect control work to the application of insecticides and fungicides, in the form of a dust rather than a spray. Reports indicate that for some purposes the dust applications are fully as effective, and usually made more rapidly and at less expense, than the generally adopted sprays.

As a method of applying contact insecticides the use of dusts is quite recent. In 1916 it is reported that Mr. Ralph E. Smith successfully demonstrated the use of nicotine-sulphate in dust form, in the control of the Walnut aphis in California, using the formula, nicotine sulphate 2% in a carrier of kaolin, with 25% lime. The method proved so successful that dusting has entirely superseded spraying for the Walnut aphis, and in 1920 the Walnut Growers' Association made and distributed for this purpose 450 tons of the dust. Modifications of this formula have subsequently been tried out in California on a number of insects. Essig (Circular 223, University of California Agricultural Experiment Station, 1920), found that a 5% nico-dust gave fully as good results, and had many advantages over spraying for the Pear thrips. Also working in California, Mr. Roy E. Campbell (Circular 154, United States Department of Agriculture, 1921), has experimented with nicotine dusts and sprays against the Melon aphis, Cabbage aphis, Onion thrips, Pea aphis and Cucumber beetles, and summarizes his experience as follows:

> Dusting requires much less material, and may be done in a much shorter time, with a less expensive machine, and at about half the cost of spraying.
>
> The action of the dust is similar to that of nicotine-sulphate spray, but much more rapid.
>
> Nicotine-sulphate dust has proved superior to spraying for the Melon aphis, Cabbage aphis, Onion thrips, Cucumber beetles, and some other insects, giving usually a better killing at a smaller cost, and with greater speed and ease of application.

In view of these reports it seemed of interest to make some observations on the effect of nico-dust on the Sugar Cane Leafhopper. The dust used was one of the combined dusts manufactured by the Walnut Growers' Spray Manufacturing Company, of Los Angeles, and composed of not less than 5.9% nicotine-sulphate, 44% inert carrier, and 50% sulphur dust. It was applied with a hand duster. The spray used for comparison was used at the strength found satisfactory by Mr. Pemberton, nicotine-sulphate 1 part, to water 1000 parts, with about 2 lbs. whale oil soap to each 50 gallons water. An ordinary knapsack sprayer was used in application.

The tests with the nico-dust were made in field No. 13A, at Ewa plantation. This was H 109 cane, planted in December, 1920, and had made so large a growth as to make the dusting and spraying a difficult matter, but at this time no fields of smaller cane could be found which were sufficiently infested to be used in this

work. Field No. 13 has been observed to be quite free of hoppers until June and July, when a slight infestation began to develop over a small part of the field. Adults were present in fair numbers, sufficient to cause some blackening of the cane in this small area in the first part of July, but on July 21 had largely disappeared. A brood of newly hatched nymphs was present, however, in quite large numbers.

The first trial of the dust was made on July 21. In order to get some idea of the effectiveness of the dust and sprays, strips of cloth five feet in length were placed on each side of a cane row, and the hoppers falling thereon were collected and counted.

The result of the dusting on July 21 was:

Adult hoppers	25
Nymphs	2,300

The nymphs at this time were very small, and an examination of the cane after dusting disclosed a few still apparently not affected.

In the curled up spindles from 15 to 20 nymphs had escaped the dust.

On July 27, six rows were sprayed and six rows were dusted. The resulting kill per five-foot row apparently was:

Dusted:	Adults	142	Sprayed:	Adults	23
	Nymphs	5,800		Nymphs	2,200

On August 2, a five-foot distance in both these plots was dusted to determine the number present a week after the first treatment.

From plot previously dusted:		From plot previously sprayed:	
Adults	151	Adults	319
Nymphs	550	Nymphs	1,350

On August 3, three rows were dusted and three rows were sprayed. No counts were made at the time, but a five-foot distance in both plots was dusted August 11 to determine the number present a week after treatment.

From plot previously dusted:		From plot previously sprayed:	
Adults	69	Adults	262
Nymphs	200	Nymphs	304

By August 11 the nymphs were half grown or more, and very few newly hatched ones were present. Newly matured adults were also appearing. Three rows were dusted and three sprayed. The result was:

Dusted:	Adults	761	Sprayed:	Adults	230
	Nymphs	967		Nymphs	373

On August 17, a five-foot distance in both these plots was dusted to determine the number present after treatment.

From plot previously dusted:		From plot previously sprayed:	
Adults	160	Adults	290
Nymphs	150	Nymphs	150

On August 17, distances of five feet along the rows were dusted with the following results:

From plot dusted July 27:		From plot sprayed July 27:	
Adults	190	Adults	561
Nymphs	33	Nymphs	362
From plot not previously treated.			
Adults	524		
Nymphs	496		

Remarks.

It will be seen from the counts above that the dusting gave a rather better kill in the plots than the spraying at the strengths used. The counts made on the first application, however, are somewhat misleading, in that the dust appeared to act faster, and once a hopper fell onto the cloth it was apt to be overcome, partly from the dust that had settled there. With the spray, on the other hand, the hoppers would continue to move about, and perhaps were not so apt to be caught on the cloth. Also the hoppers appeared to be rather unevenly distributed, which interferred with a very accurate comparison. The check treatments made a week or more later gave a much better comparison. The adult hoppers no doubt move back on the treated plots, but the nymphs killed in subsequent treatment would seem to indicate the relative effectiveness, as very few newly hatched ones appeared after July 27th. In every case it will be noted that fewer nymphs were secured in the checks on plots that had been dusted than on those that had been sprayed. It should also be noted that the total number of hoppers secured from an equal distance on previously untreated cane on August 17th was less than one-fifth the number secured from a like distance on July 27th, which would seem to indicate an enormous natural mortality in the developing nymphs.

The fact that the dust remained on the leaves for several weeks after the treatment may in part explain the smaller number to be found on those plots later, as there may be some repellent value in the dust.

To make an accurate estimate of the relative expense of the two methods from an experiment on such a small scale would be very unsatisfactory. It was possible in the cane worked in to dust thoroughly about three times as fast as to spray. In dusting, a considerable amount of waste in the application of the material occurred, the application being at the rate of from 100 to 125 pounds per acre roughly. The spray was applied at the rate of over 300 gallons per acre. The area of cane treated, as well as the amount of material required, would vary very widely according to the size of cane being treated. From the time required in applying to these very small areas, it was estimated that one man might dust as much as an acre and a half or two acres in a day.

Effect on Parasites.

In examining the material collected from the sprayed and dusted plots, small numbers of insect predators, spiders, were obtained, though in general these appeared to be resistant.

In only one case were the leafhopper egg parasites found in numbers. The

dusted plot July 27 showed 80 *Ootetrastichus beatus,* 50 *Ootetrastichus formisanus,* and 270 of the Mymarid parasites. The same plot August 2 yielded 90 *Ootetrastichus beatus,* 26 *Ootetrastichus formisanus,* and 100 Mymarids.

Concluding Remarks.

During the present season the infestation by leafhopper at Ewa, as well as on the other plantations on Oahu, has been so light that the need for any artificial control would seem to be very slight. In seasons of heavier infestation, or in other localities, a series of experiments might be conducted to determine the practical value as determined by an increased yield sufficient to justify expense involved. Observations at Ewa during the past year would seem to indicate that the infestation in cane, small enough to be easily worked in, is usually light or of short duration, the heavier infestations usually being in fields of six months to a year's growth, where the difficulties of any artificial control are greatly increased.

Boiler Explosions in the United States During 1920.*

The year 1920 produced the largest number of boiler accidents so far recorded. The total accidents amounted to 652, which is greater by 102 than the largest previous year, 1909, when the number was 550. The number of persons killed and persons injured has, on the other hand, fallen below the average figure of recent years, 1920 showing a total of 137 killed and 262 injured.

The monthly figures for number of accidents, persons killed, persons injured, and total of killed and injured are given in the table below.

SUMMARY OF BOILER EXPLOSIONS FOR 1920

Month	Number of Explosions	Persons Killed	Persons Injured	Total of Killed and Injured
January	86	13	27	40
February	66	12	20	32
March	53	9	23	32
April	47	12	9	15
May	36	5	11	16
June	31	8	21	29
July	41	16	22	8
August	36	5	29	34
September	42	15	25	40
October	53	17	15	32
November	87	18	22	40
December	74	7	38	45
Totals	652	137	262	399

[W. E. S.]

* From "The Locomotive."

High Temperature Bacteria in Hawaiian Sugar Factories.

By C. W. Carpenter *and* H. F. Bomonti.

The experiments of H. S. Walker and A. Fries, cited in the 1920 report[1] of the committee on juice deterioration indicate that bacteria are active in hot juices. In this report W. R. McAllep states that while no investigation has been made in Hawaii to detect the presence of high temperature organisms, there are strong indications that such organisms are present in our mills. The reader is referred to the committee report for the detailed discussion of the experiments, which have led to the investigation herein reported.

Thermophilic Bacteria.

Bacteria capable of growth at temperatures above 50° C. (122° F.) are called thermophilic bacteria. These bacteria were discovered by Miquel in 1879, and since then have been reported upon by various investigators. They are frequent inhabitants of the waters of hot springs, but are also surprisingly common in soil, manure, surface waters, etc. Many of them are spore formers and by means of these spores are capable of standing boiling temperatures for some time. Since they are incapable of growth at ordinary temperatures, but in general start at temperatures above 40° C. (104° F.), with their optimum often between 60° and 70° C. (140°-158° F.), it is a subject of conjecture as to where in nature they find opportunity for development. It is thought that much of their development takes place in association with the thermogenic or heat producing bacteria in decaying organic matter.

As to the occurrence of thermophiles in mill juices, the literature is very scanty. Shöne[2] records one group of bacteria whose optimum temperature for growth is said to be 50° C. (122° F.). D. S. North, in unpublished studies, seems to have been one of the first to recognize the significance of these bacteria to sugar manufacture. In general mycologists and bacteriologists have investigated in sugar products only those micro-organisms which are associated with the deterioration of stored sugars at ordinary temperatures.

In the investigation reported below, the results of a preliminary survey of the deterioration of hot clarified juice by bacteria are recorded. In this investigation the senior author has handled the bacteriological work and the junior author the chemical studies.

Deterioration Due to Thermophilic Bacteria in Hot Juices.

First an attempt was made to demonstrate the existence of active bacteria in clarified juice at temperatures above 60° C. (140° F.). Following success in this matter the bacteria were isolated and cultivated at these temperatures (60°–

[1] Report of the committee on juice deterioration. In Hawaiian Planters' Record, Vol. XXIV, No. 5, p. 198–203, 1920.

[2] Shöne, Albert. De microorganismen in de sappen der Suikerfabrieken. *In* Archief voor de Java Suikerindustrie, Vol. XI, 786–801, 1905. Abstract. Intern. Sugar Journ., Vol. VII, p. 523–526.

70° C.); experimental inoculations of sterile juices and sugar solutions were made, and the latter incubated under carefully controlled conditions. In the beginning the cultures and flasks of inoculated solutions, etc., were incubated in electric incubators, but it was soon found that the temperatures varied considerably in different parts of the chambers. To insure accurate temperature control a water-jacketed incubator with an inner water bath in which the cultures could be immersed was arranged. The temperature of the water bath was constantly recorded with a Bristol thermometer whose sensitive bulb was completely immersed therein. This thermometer was accurately adjusted to correspond with a mercurial thermometer tested by the Bureau of Standards. The temperature in different parts of the bath was found to vary less than one-half degree centigrade.

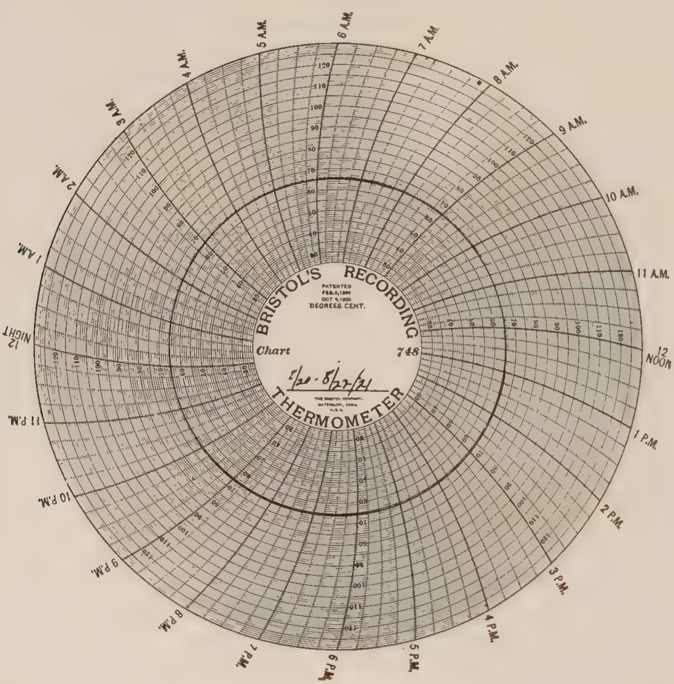

Figure 1.—Temperature chart from the Bristol recording thermometer, showing the incubation temperatures over a 48-hour period.

A quantity of mixed juice was obtained from a nearby plantation. Two-hundred c.c. portions were placed in Erlenmeyer flasks, each portion being then limed with 0.75 c.c. of milk of lime. One set of flasks was sterilized in an autoclave at 30 pounds pressure (130° C.); another set was brought to a boiling temperature; some flasks of both sets were then incubated at the following temperatures: 50°, 60°, 70°, and 80° C. (122°, 140°, 158°, 176° F.). After incubation periods of 18 and 42 hours the juices were analyzed, the results being shown in Table I, where purity indicates apparent purity, which is Pol. / Brix.

TABLE I—DETERIORATION OF BOILED JUICE AND STERILE JUICE.

Hours	50° C.				60° C.			
	Boiled Juice		Sterile Check		Boiled Juice		Sterile Check	
	Purity	Decrease	Purity	Decrease	Purity	Decrease	Purity	Decrease
0	88.94	....	86.65	....	88.94	....	86.65	....
18	88.95	+ 0.01	86.33	0.32	88.35	0.59	85.89	0.76
42	86.47	2.47	85.63	1.02	84.47	4.47	85.34	1.31
	70° C.				80° C.			
0	88.94	....	86.65	....	88.94	....	86.65	....
18	88.55	0.39	86.15	0.50	85.91	3.03	84.14	2.51
42	83.83	5.11	83.82	2.83	84.26	4.68	78.62	8.03

This experiment gave strong indication that there was bacterial growth as high as 70° C. There is a marked difference in decrease in purity between the juices sterilized and those only brought to the boiling point. It was found that duplicate checks (sterilized) incubated at 80° C. varied as much as 10 points, and for this reason the results at this temperature must be disregarded. At the other mentioned temperatures the duplicate analyses agreed closely.

The juices in the above experiment were filtered with kieselguhr through hardened filter paper. Examination of these filtered juices failed to show the presence of bacteria, and it is our experience that such filtration of juices after shaking up with kieselguhr removes the greater number of the organisms. In the following experiment the juices which had been heated only to boiling and incubated showed a large number of bacteria before filtering.

The experiment, the results of which are shown in Table I, was repeated at approximately 65° and 75° C. The results of the analyses are shown in Table II.

TABLE II—DETERIORATION OF BOILED JUICE AND STERILE JUICE.

Hours	65° C.					
	Boiled Juice			Sterile Juice		
	Reaction:[1] Per Cent CaO	Purity	Decrease	Reaction: Per Cent CaO	Purity	Decrease
0	.014 alk.	83.36	....	.014 alk.	82.39	....
22	.040 acid	80.42	2.94	.020 acid	82.12	0.27
46	.072 acid	75.97	7.39	.030 acid	81.80	0.59
	75° C.					
0	.014 alk.	83.01	....	.014 alk.	82.46	....
22	.030 acid	81.46	1.55	.020 acid	82.07	0.39
46	.055 acid	76.57	6.44	.030 acid	79.92	2.54

[1] Reaction determined with litmus as indicator.

In this experiment there are the same decreases in purity as shown in Table I. The two experiments showed that bacteria were probably responsible for the deterioration noted, and thermophilic organisms were promptly isolated by the poured plate method, incubation being carried on in a moist chamber at 65° C. (149° F.). Inoculation experiments were then inaugurated to determine, if possible, the effect of these organisms in hot juices.

In one experiment six 100 c.c. volume flasks were sterilized. Clarified juice was shaken up with kieselguhr and filtered aseptically. Into each flask 75 c.c. of juice was pipetted. A sample of the juice was also taken for immediate chemical analysis. The six flasks of juice were then heated to 65° C. in a water bath, and three inoculated with one c.c. of a 48-hour culture on bouillon. The other three received the same amounts of sterile bouillon. The inoculated and control flasks were then incubated at 65° C.

The results of this inoculation experiment are given in Table III.

TABLE III—COMPARATIVE ANALYSES OF INOCULATED JUICE AND STERILE JUICE.

Hours at 65° C.	Purity of Inoculated Juice	Reaction:[1] Per Cent CaO	Decrease in Purity	Purity of Sterilized Control	Reaction: Per Cent CaO	Decrease in Purity
0	78.57	.019 acid	....	78.57	.018 acid	....
16	78.00	.030 acid	0.57	78.57	.020 acid	....
40	75.32	.035 acid	3.25	78.45	.024 acid	0.12
64	73.43	.040 acid	5.14	78.40	.025 acid	0.17

The acidity of the inoculated juice increases very rapidly, accompanied by a decrease in purity amounting to 5.14 in 64 hours. The control juice slightly increases in acidity, while the purity remains nearly constant with a decrease of but 0.17 after 64 hours.

The appearance of the inoculated juice is in marked contrast to the uninoculated. The latter remained clear and bright and of brownish red color throughout incubation, while the former was turbid in 24 hours and of a yellowish color. The inoculated juice also has a fermented acid odor, while the control retains the characteristic odor of the original juice. Similar results were obtained with clarified juice from another mill.

In several additional experiments with clarified juices and sugar solutions the results indicated the destruction of dextrose after inversion of the sucrose. A typical example of this action is shown by the analyses recorded in Table IV. Clarified juice sterilized in flasks at ten pounds pressure for fifteen minutes was used.

[1] Reaction referred to phenolphthalein as indicator.

TABLE IV—COMPARATIVE DATA ON STERILE JUICE AND INOCULATED JUICE.

	Sterile Juice	Inoculated Sterile Juice
Original apparent purity	82.18	82.18
Original reaction (% CaO)	.015	.015
After 36 hours at 65° C.		
Reaction	.018	.036
Apparent purity	82.07	80.52
Gravity purity	83.33	82.56
Invert sugar	0.64	0.65

In the above experiment by gravity purity we mean $\frac{\text{Sucrose (Clerget)}}{\text{Brix}}$; sucrose was determined by the method outlined in "Methods of Hawaiian Chemists' Association."

The difference between the gravity purity and the apparent purity of the sterile juice is 1.26, while in the inoculated juice the difference between the gravity purity and the apparent purity is 2.04. With practically the same per cent of invert sugar we would expect these differences to be the same. It seems very probable that the invert sugar of the inoculated clarified juices consists of a larger per cent of levulose than that of the sterile check. This would account for the larger difference between gravity purity and apparent purity. We recognize the possibility that invert sugars are precipitated by Horne's dry lead, which might account for the differences mentioned, if we had not obtained similar results with sugar bouillon solution where no lead was used for clarification. This seems to indicate that dextrose is destroyed.

We believe that this organism destroys invert sugar forming an organic acid. This acid at the high temperatures 60°–75° C. (140°–167° F.) inverts sucrose forming more invert sugar. The acidity of the deteriorated juice does not increase beyond the equivalent of 0.050 per cent CaO, referred to phenolphthalein as an indicator.

The bacteriological studies failed to show any bacteria capable of growth at temperatures above 73° C. (164° F.).

Nature of the Thermophilic Bacteria of Mill Products.

Bacteria capable of growth at temperatures from 45° to 73° C. have been isolated in our investigations from hot juice from the filter presses, clarified juice, sugar from the centrifugals as well as the final product, and from the Experiment Station tap water. In one attempt such organisms were not detected in refined sugar from the granulator.

Thirty-eight samples of raw sugar from as many factories collected in routine sampling were examined as follows for the presence of thermophilic bacteria: Plugged culture tubes were sterilized at 19 pounds pressure for fifteen minutes in the autoclave; into each was poured about one gram of sugar. About ten c.c. of sterile distilled water was added to each tube with a sterile pipette and the tubes heated in a steamer at about 99° C. for one-half hour. The tubes

of sugar solution were then incubated at 62° C. (144° F.). Microscopic examination the following day showed bacteria present in all samples; whether these were living thermophiles in every case is somewhat doubtful since when transfers from these tubes to bouillon were incubated at 62° C. but 26 out of the 38 grew in 24 hours. The presence of growth was judged by the clouding of the medium.

These samples of raw sugars were taken in unsterilized containers and they were exposed to the possibility of bacterial contamination one to another before they were obtained for the tests above described. We cannot state that these high temperature bacteria are present in all mills, but the evidence supports the view that they are widely distributed.

Morphologically the various cultures made have not been studied to the point where we can express an opinion as to whether we are dealing with one species or with a group of bacteria. The preliminary work indicates that there are at least varieties present rather than a single constant species.

The particular strain of thermophilic bacteria on which the following notes are based does not agree in its morphology with any named species, though it must be said that the descriptions of bacteria of this sort are in general too meagre to allow identification. The characters of the organism which are likely to be of practical benefit, as well as certain salient features which may serve for identification purposes are recorded below. Since this organism cannot be definitely identified with any previously named species, the name *Microspira Northii* is proposed, which suggests D. S. North, who has in unpublished work dealt with a similar, if not identical, form.

This organism takes the form of short rods (2.5–4.0 μ), long rods (4.5–8.0 μ), and interwoven chains of great length. The diameter varies from 0.75 to 1.5 μ, in the same preparation. The rods appear straight, or nearly so, but careful examination shows a slight curvature of the longer rods and chains, with **S** forms and spirals rather infrequent. The great variation in diameter of the rods and relatively infrequent **S** forms suggest a mixed culture, but the two types have not been separated by repeated platings. Therefore the organism must be classed in the genus *Microspira* of *Migula*, characterized by slightly curved rods and **S** forms. The rods are motile by means of three to ten or more trichiate[1] flagella (Plate I) of great length. Sluggish motility continues for several minutes after the preparation cools to room temperature. Flagella were demonstrated by means of a modified Loeffler's method, with carbol-fuchsin or anilin water gentian violet as the final stain.

The organism grows well on slightly acid bouillon and bouillon agar. The presence of sugar in the bouillon or agar does not seem to insure a better growth. No growth occurred in synthetic media tried, such as Uschinski's, Fermi's, and Cohn's solutions with sucrose added.

The colonies (text figure 2) on bouillon agar appear in 24 hours at 65° C.; in two to three days they are from two to five millimeters in diameter. Surface colonies are smooth, rounded, entire, and pearly white in color. Buried colonies are more irregular in appearance, with short processes of chains invading the medium. In the surface colonies we find shorter and thicker rods, while in the

[1] Not restricted to any particular part of the organism.

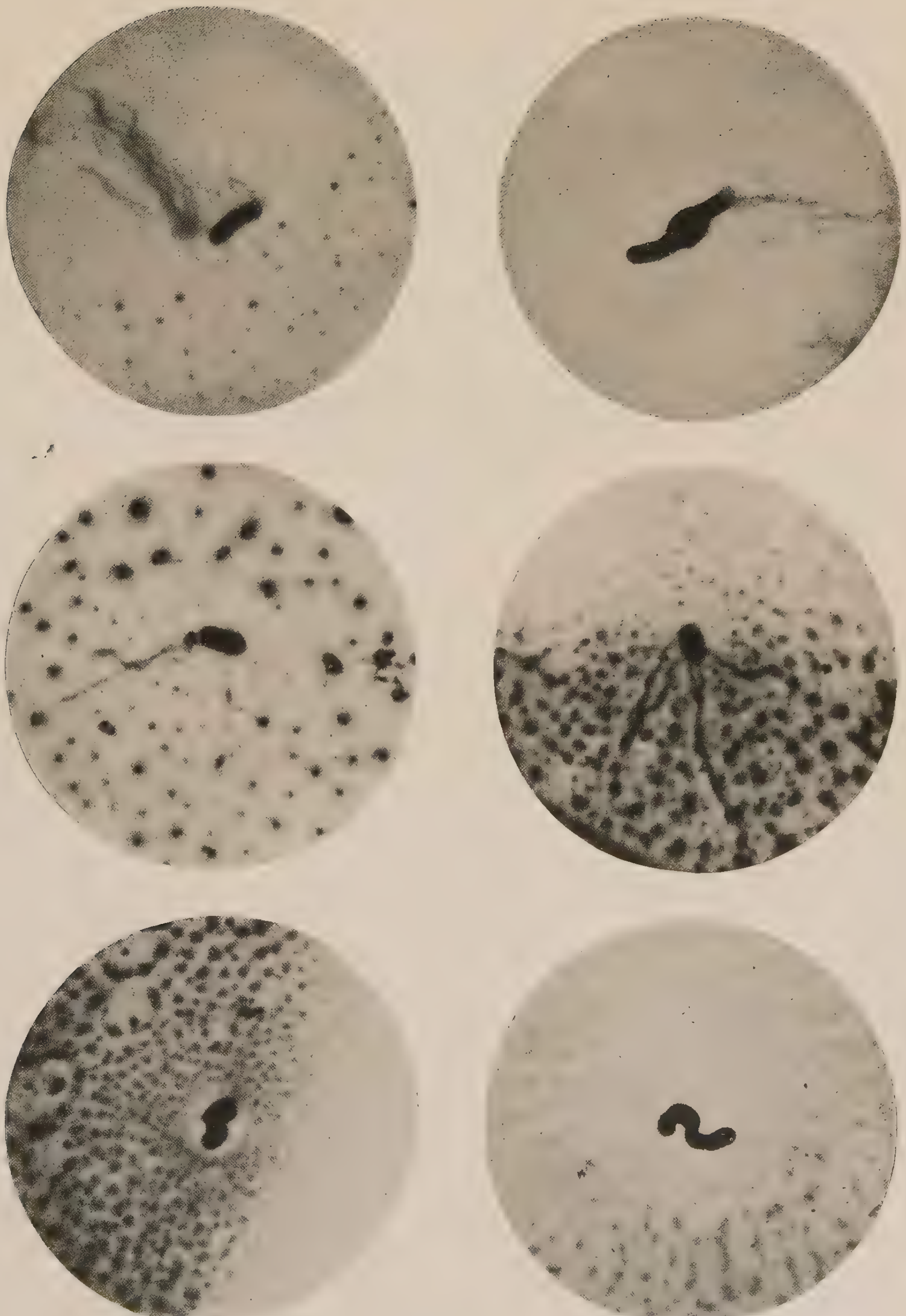

Plate I.

Microspira Northii nov. spec. $\times$ 2000.

All the bacteria illustrated in the six figures were stained by Loeffler's method for flagella.

Fig. 1. A long curved rod form with peritrichiate flagella.

Fig. 2. Spore forming long rod form or short chain bearing flagella.

Fig. 3-4. Short rod forms with peritrichiate flagella.

Fig. 5-6. Short and long S forms.

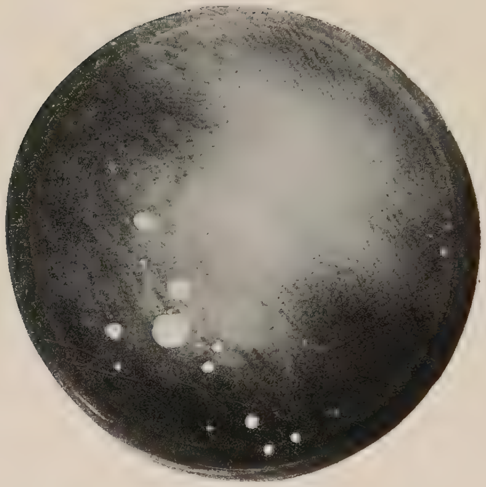

Figure 2.—Colonies of **Microspira Northii** nov. spec. on standard bouillon agar. Incubated three days at 65° C. (149° F.). × 3/5.

buried colonies we find long, thin chains. The growth on agar indicates preferment for plenty of oxygen.

On bouillon medium a distinct, though rather moderate, clouding can be detected in 24 hours or less at 65° C. in the upper portion of the liquid, and if the tube be inclined, a thin, flaky pellicle (scum) is to be noted. This becomes more conspicuous with age and settles as a flaky precipitate. No change in color of either agar or bouillon was detected except that the increasing turbidity in bouillon makes the medium lighter in appearance.

Spores may be formed in less than 24 hours, and are detected by the egg-shaped swelling in the center of the rods. They may be readily seen without the aid of stains. The spores measure about $2.5 \times 3.0\ \mu$ and are readily demonstrated by staining with carbol-fuchsin. Rods which are possibly short chains are often seen moving actively with a spore at or near the center. The writers could never be certain that single cells acted in this manner, but considered it probable that in short chains of two or more elements younger cells were actively motile while a mother cell had formed a spore. Flagella on a spore forming short chain (?) are illustrated in Plate I, Fig. 2. These spores stand boiling for some time at least, but in our experience may be killed by steaming at 15 pounds pressure for fifteen minutes. The bacteria remain unstained by Gram's method. The organism on culture media did not show a special predilection for sugar, either sucrose or dextrose. It did not form gum. A moderate amount of gas was liberated in sugar bouillon.

The minimum temperature for growth was 46° C., since at this temperature no growth occurred in 24 hours, but a scanty growth was to be detected in 48 hours. The maximum temperature at which growth has been detected was at 73° C. (164° F.). The optimum temperature is from 65° to 70° C. Another strain but slightly studied has a somewhat lower minimum as well as maximum

temperature for growth. No growth was secured in culture media with a concentration greater than about 25° Brix, cane sugar being added to bouillon.

As above noted this thermophile is somewhat anomalous in its characters. Most thermophilic bacteria are non-motile. Motile thermophilic bacteria have, however, been mentioned by Shöne (l. c.), Falcioni[1] and Georgevitch[2]', the two latter having worked with bacteria from hot springs. Our organism is not only motile, but has some spiral forms, though no flagella were detected on strictly spiral forms, which are rather rare. Motile spiral bacteria normally have one or more polar flagella and sometimes a bipolar arrangement of the flagella. In contrast we have a motile thermophile with apparent relation to the genus *Microspira*, but with a peritrichiate arrangement of flagella, an anomalous condition which renders further careful work necessary before its classification can be satisfactorily determined.

Microspira Northii nov. spec.

Vegetative cells are short and long rods with rounded ends; short rods 2.5 to 4.0 μ, long rods 4.5 to 8.0 μ. Chains of varying length and diameters. The diameter of the elements varies from 0.75 to 1.5 μ. Rods straight to slightly curved with **S** forms, short and long spirals infrequent. Irregular orientation in general the chains being interwoven particularly in buried colonies; occasionally surface colonies show a parallel arrangement of the elements. The rods are motile by means of three to ten or more paritrichiate flagella several times the length of the rods.

Central egg-shaped endospores, measuring 2.5 x 3.0 μ, are formed in less than 24 hours, the spore bearing elements often continuing actively motile. Capsules were not detected. The rods are readily stained with either carbol-fuchsin or gentian violet. Flagella were demonstrated with a modified Loeffler's method and either carbol-fuchsin or anilin water gentian violet for the stain. The cells remain almost entirely unstained by Gram's method.

This organism is aerobic and grows well in 24 hours on standard bouillon and bouillon agar. On bouillon a moderate clouding and fragile pellicle are evident in 24 hours at 65° C. At the same temperature on agar a filiform, raised, entire, pearly white, smooth, glistening growth appears in 24 to 48 hours. Agar colonies are rounded, raised, entire, pearly white, smooth and glistening. Buried colonies are more irregular with short processes of intertwined chains. Gas formed in sugar bouillon as evidenced by sufrace bubbles; none detected in fermentation tubes with clarified juice. Acid formed in sugar bouillon and clarified juice. No gums were detected.

No growth occurred on any synthetic medium tried. Cohn's, Uschinski's and Fermi's solutions with sucrose added were among those used. One strain of thermophile grew on these media, indicating varieties among thermophiles of sugar factories.

Concentration of the medium: No growth was detected in sugar bouillon with a concentration greater than 25 Brix.

Temperature relations: Optimum temperature for growth 65° to 70° C. Maximum temperature for growth, 73° C. Minimum temperature for growth, 46° C.

Classification: The morphology of the particular strain of thermophile studied was somewhat anomalous with respect to systems of classification. The

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[1] Falcioni, D. I germi termofili nelle acque del Bullicame (Arch. de farmocol. sperm. 1907, No. 1.) *In* Centralb. f. Bakt. Bd. XX, p. 164, 1907.

[2] Georgevitch, Peter. *Bacillus thermophilus* Jivöini *nov. spec.* and *Bacillus thermophilus* Losanitchi *nov. spec.* *In* Centralb. f. Bakt. Bd. XXVII, p. 150–167. 1 pl. 1910.

organism is a motile spiral thermophile with peritrichiate flagella. The name *Microspira Northii* is proposed for this organism, suggesting D. S. North, who has discussed in unpublished studies a high temperature organism in sugar factories.

Summary.

1. Bacteria capable of growth at temperatures from 46°-73° C. (115°-164° F.) are common inhabitants of mill products.

2. Such bacteria were detected in juice from the filter presses, clarified juice in the settling tanks, in sugar from the centrifugals and bagging machine. Similar thermophilic bacteria were also detected in the Experiment Station water supply.

3. Thermophilic bacteria isolated from clarified juice were found to be acid formers and capable of bringing about inversion of sucrose at temperatures from 50° to 70° C. (122°–158° F.).

4. The strain particularly studied destroys sucrose by acid inversion, forms no gum, in the spore stages withstands boiling an undetermined time, and grows in solutions with concentrations up to 25° Brix.

5. These thermophiles are motile, spore forming rods of varying lengths and diameters; curved S and spiral forms occur occasionally.

6. This selected strain is provisionally called *Microspira Northii* nov. spec., its morphology being somewhat anomalous with respect to systems of classification.

A Phosphoric Acid Test.

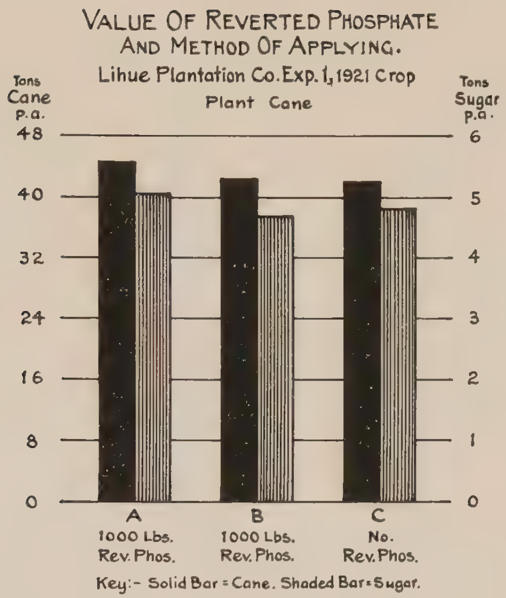
Lihue Plantation Experiment No. 1, 1921 Crop.*

This experiment was planned to determine the value of phosphoric acid, and to compare the time and method of application on the makai lands of the Lihue District.

Reverted phosphate was applied at the rate of 1000 pounds per acre. In one case it was applied broadcast and harrowed in before furrowing; while in the other it was applied in the furrow with the seed; in a third series of plots no phosphate was applied. All plots received a uniform dose of 125 pounds of nitrogen per acre. The cane was Yellow Caledonia plant in a field which had been fallowed for one year. The trash from the previous crop was plowed in and stock was pastured on the field during the period of fallowing.

The results show no definite gain for the phosphate. While the average yield for the reverted phosphate harrowed in shows a slight increase over no phosphate, the increase is so small as to be within the limits of experimental

* Experiment planned and laid out by R. S. Thurston. Results calculated by J. A. Verret and Y. Kutsunai.



error. On the other hand, phosphate with the seed shows no increase over no phosphate. The following tabulation shows the treatments and yields.

Plot	Treatment	Tons per Acre		
		Cane	Q. R.	Sugar
A	Reverted phosphate harrowed in ..	44.67	8.83	5.06
B	Reverted phosphate with seed.....	42.39	8.99	4.72
C	No phosphate	42.03	8.71	4.83

This negative response of cane to phosphate fertilization corroborates experiments conducted on Grove Farm plantation in this same type of soil. This lack of response of these makai soils is in marked contrast to the mauka soils, which respond very profitably to phosphate.

This experiment is to be repeated to note any possible effect on ratoons.

DETAILS OF EXPERIMENT.

Object:

(1) Comparing broadcasting and harrowing in before planting with applying in furrow with seed.

(2) Value of.

Location:

Field 1.

Crop:

Yellow Caledonia, plant cane.

Layout:

Number of plots: 26.

Size of plots: 1/10 acre each (108′ x 40.3′), composed of 24 straight lines one watercourse long. Rows 4.5′ x 40.3′.

Plan:

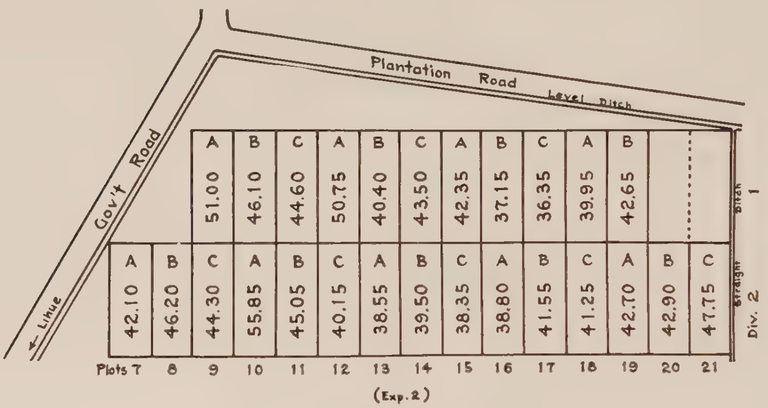
Plots	Number of Plots	Treatment
A	9	1000 lbs. per acre reverted phosphate applied broadcast and harrowed in before furrowing.
B	9	1000 lbs. per acre reverted phosphate applied in furrow at time of planting.
C	8	No reverted phosphate.

All plots to receive uniform fertilization in form of nitrate of soda. Amount to depend on appearance of cane.

VALUE OF REVERTED PHOSPHATE AND METHOD OF APPLYING.

Lihue Plantation Co. Exp. 1, 1921 Crop

Plant Cane



Summary of Results

Plot	No. of Plot	Treatment	Yields Per Acre		
			Cane	Q.R.	Sugar
A	9	1000# Reverted Phosphate per acre broadcast + harrowed in.	44.67	8.83	5.06
B	9	1000# Reverted Phosphate per acre applied in furrow.	42.39	8.99	4.72
C	8	No Reverted Phosphate	42.03	8.71	4.83

PROGRESS OF EXPERIMENT.

April 2–10, 1919—Experiment laid out.
April 12, 1919—Applied phosphate to A plots.
April 23, 1919—Applied phosphate to B plots.
June 5, 1919—Staked.
Setember 12, 1919—Erected signs.
March 4, 1920—Fertilized with nitrate of soda.
April 1–23, 1921—Harvested by J. H. Midkiff.

R. S. T.

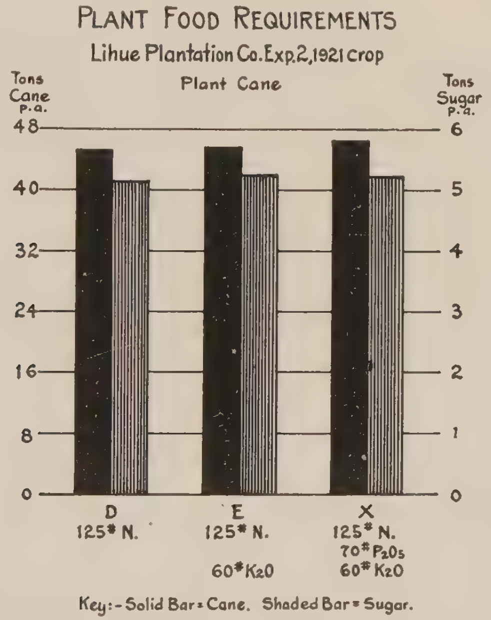
Phosphoric Acid and Potash at Lihue.

LIHUE PLANTATION — EXPERIMENT 2, 1921 CROP.*

The object of this experiment is to determine whether the makai soils of the Lihue district need phosphoric and (or) potash in addition to nitrogen.

All plots received a uniform dose of 125 pounds of nitrogen per acre. The E plots received, in addition to the nitrogen, 60 pounds of potash, while the X plots received 70 pounds of phosphoric acid and 60 pounds of potash per acre.

The cane is Yellow Caledonia plant on land which was fallowed one year. The trash from the previous crop was plowed in, and the field was pastured to stock during the fallow period.



The variation in yield between the different treatments is so slight as to be within the limits of experimental error. In other words, the presence or absence of either or both phosphoric acid and potash makes no difference in the yields. The following tabulation shows the treatments and yields.

Plot	Fertilization—Pounds per Acre			Yield in Tons per Acre	
	N	P_2O_5	K_2O	Cane	Sugar
D	125	0	0	45.23	5.15
E	125	0	60	45.61	5.24
X	125	70	60	46.58	5.22

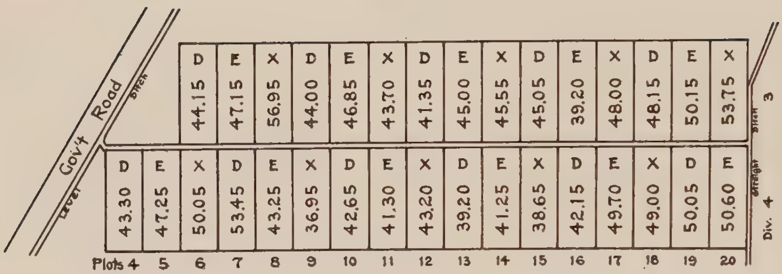
This experiment is to be repeated to note possible effect on ratoons.

* Experiment planned and laid out by R. S. Thurston. Results calculated by J. A. Verret and Y. Kutsunai.

PLANT FOOD REQUIREMENTS

Lihue Plantation Co. Exp. 2, 1921 Crop

Plant Cane



(Exp. 3.)

Summary of Results

Plots	No. of Plots	Treatment			Yields Per Acre	
		Nitrogen	P_2O_5	K_2O	Cane	Sugar
D	11	125	0	0	45.23	5.15
E	11	125	0	60	45.61	5.24
X	10	125	70	60	46.58	5.22

DETAILS OF EXPERIMENT.

Object:

To determine the need of phosphoric acid or (and) potash.

Location:

Field 1.

Crop:

Yellow Caledonia plant, on land fallowed one year. Trash left on field and stock allowed to run thereon.

Layout:

Number of plots:. 32.

Size of plots: 1/10 acre each (108′ x 40.3′), composed of 24 straight rows, each one watercourse long. Rows 4.5′ x 40.3′.

Plan:

Plots	Number of Plots	Fertilization		
		N	P_2O_5	K_2O
D	11	125	0	0
E	11	125	0	60
X	10	125	70	60

Nitrogen from nitrate of soda.
P_2O_5 from reverted phosphate.
K_2O from molasses ash.

PROGRESS OF EXPERIMENT.

April 2–10, 1919—Experiment laid out.
July 9, 1919—Experiment staked.
August 5, 1919—First fertilization.
March 4, 1920—Second fertilization with nitrogen.
April 1–22, 1921—Harvested by J. H. Midkiff.

[R. S. T.]

The Value of Boiler Inspections.*

Not long ago one of our inspectors made a visit to a plant for an internal inspection of a horizontal return tubular boiler, and while in the furnace he noticed a brownish stain on the shell, well up on the side where the brick wall of the furnace and the shell join. To his trained eye this indicated a leak and he thereupon questioned the chief engineer as to whether any leakage had been noticed. The reply was in the negative, but our inspector nevertheless was not satisfied. Climbing on top of the boiler he proceeded to learn, if possible, the source of the leak that had caused that stain on the boiler shell. The engineer called his attention to a water pipe running across and somewhat above the boiler, mentioning that considerable condensation collected on this pipe and that possibly there was some water reaching the boiler from this source. This did not seem an altogether satisfactory explanation, however, so the inspector ordered some of the asbestos covering of the boiler removed at a point where he believed a leak might be. The boiler was then filled with water under pressure, and it was probably somewhat of a surprise to all present but the inspector to see water spraying out through a crack in the boiler shell as shown in the photograph herewith. The leakage was through a lap seam crack and it is practically certain that this boiler would have caused a disastrous explosion if it had remained in service. The watchful eye of the inspector, however, prevented further use of the boiler and thereby safeguarded life and property.

The case just cited brings to our mind a somewhat similar one, in which the owner had repairs made and only by good fortune was a serious accident averted. The engineer of the plant, a laundry, noticed some steam issuing through the covering of the boiler and upon investigation found that the steam came from a crack in the shell of the boiler. The crack was of the lap seam type, but the owner did not know its dangerous character and neither did the self-styled "boiler-maker" he called in for advice. This "expert" said, "That's all right. Go ahead and use her till the end of the week and then shut her down. I'll be over Sunday and weld her up." He apparently did not know that autogenous welding in a case of this kind is a most dangerous practice, or else he had no regard for the safety of the fifty girls at work directly above the boiler.

One of our inspectors heard of the case and made a visit to the place. As

* From "The Locomotive."

Water issuing from a lap-seam crack.

soon as he saw the nature of the leak he advised an immediate shutdown of the boiler and also told the owner that the contemplated repairs would not make the boiler any less dangerous to operate.

A few days later a hydrostatic test was applied to the boiler and the results were practically identical with the first case mentioned. The demonstration and the inspector's explanation of the serious nature of the defect were sufficient for the owner, and not only the leaking boiler but also its mate, both of them of the same age, were removed and new ones installed. Had this precaution not been taken there might easily have been a repetition of the accident which accurred at the American Palace Laundry, Buffalo, N. Y., on November 3d, 1906. In this disaster the boiler, which was of the long seam type, failed as the result of a lap seam crack and four persons were killed. The property loss amounted to $12,000.

[W. E. S.]

The Problem of Rat Control.

In connection with requests from certain plantations to take up rat control work, we addressed the Bureau of Biological Survey, U. S. Department of Agriculture, asking for information and cooperation.

We are in receipt of a reply from E. W. Nelson, chief of the bureau, which reads:

"We have your letter of September 3rd requesting information on methods of controlling rats. We are sorry not to be in a position to assign one of our field experts to assist you in getting this important work under way, but we will gladly be of any possible service from here. We enclose a number of bulletins and circulars dealing with the control of rats that sum up fairly well our present knowledge on the subject. In rats you have perhaps the most difficult of all rodents to control.

"We have found the use of barium carbonate as described in circular Bi-414 to be the most efficient means of destroying rats, but success with this attends only painstaking use of varied and appetizing baits, following closely the directions in the circular. Caution of the danger attending the use of poisons generally should be emphasized. Poisoning has the disadvantage in that around dwellings and buildings an occasional rat may die in the walls, creating an offensive odor. In cases where the individual does not care to chance this, it is necessary to resort to trapping. The common, small, snap rat trap is to be recommended for this purpose. Clean premises and rat-proofing of buildings is to be recommended at all times. Starving out and building out the rat is the safest policy and the only permanent means of rat riddance.

"For poisoning in the big plantation fields, the use of squads of men covering the ground systematically with carefully prepared and varied baits is to be recommended. Barium carbonate can be secured in quantity at a very low figure and should be used freely, always keeping near the proportion of one part of barium to four or five parts of bait.

"We trust that this information will be of some benefit to you and that you will let us hear from you further regarding the progress of this undertaking."

The following matter is taken from the inclosures sent with Mr. Nelson's letter:

RATS AND MICE AS PESTS.

In the United States, rats and mice each year destroy crops and other property valued at over $200,000,000. This destruction is equivalent to the gross earnings of an army of over 200,000 men.

The common brown rat breeds 6 to 10 times a year and produces an average of 10 young at a litter. Young females breed when only three or four months old. At this rate a pair of rats, breeding uninterruptedly and without deaths, would at the end of three years (18 generations) be increased to 359,709,482 individuals.

Rat-Proofing.

Rat-proof construction is the ultimate solution of the rat and mouse problem, as the effects of all other devices are temporary. The best way to keep rats from buildings, whether in city or in country, is to use cement in construction. The processes of mixing and laying this material require little skill or special

knowledge, and workmen of ordinary intelligence can successfully follow the plain directions contained in handbooks of cement construction.

Cellar walls of dwellings should have concrete footings, and the walls themselves should be laid in cement mortar. The cellar floor should be of medium rather than lean concrete. Even old cellars may be made rat-proof at comparatively small expense. Rat holes may be permanently closed with a mixture of cement, sand, and broken glass, or of sharp bits of crockery or stone.

On a foundation like the one described above, the walls of a wooden dwelling also may be made rat-proof. The space between the sheathing and lath, to the height of about a foot, should be filled with concrete. Rats can not then gain access to the walls, and can enter the dwelling only through doors or windows. Screening all basement and cellar windows with strong wire netting, and covering all drain pipes, are most necessary precautions.

Farm buildings should be made rat-proof by a liberal use of cement in foundations and floors. Old corn cribs should have an inner or outer cover of galvanized wire netting of half-inch mesh and heavy enough to resist the teeth of rats. As rats can climb the netting, the entire structure must be screened.

All food supplies, garbage, and waste should be kept in rat-proof receptacles, and waste matter should be cared for in such fashion that it can not be eaten by rats.

Trapping.

Trapping, if persistently followed, is one of the most effective ways of destroying rats and mice.

House mice are less suspicious than rats and are much more easily trapped. Small guillotine traps baited with oatmeal will soon rid an ordinary dwelling of the smaller pests.

In trapping, several kinds of bait should be used, such as sausage, fried bacon, oatmeal, fish, fresh liver, nuts, apples, corn, sunflower seed, or toasted cheese. The bait should not be allowed to become stale, and the traps should be inspected daily.

Cage traps may be baited and left open for several nights until the rats are accustomed to enter to obtain food. They should then be closed and freshly baited, when a large catch may be expected, especially of young rats. It is better to cover the trap than to leave it exposed. A short board should be laid on the trap and an old cloth or bag or a bunch of hay or straw should be thrown carelessly over the top. Often the trap may be placed with the entrance opposite a rat hole and fitted so closely that rats can not pass through without entering the trap. If a single rat is caught it may be left in the trap as a decoy to others.

The ordinary steel trap (No. 0 or 1) may sometimes be satisfactorily employed to capture a rat. The animal is usually caught by the foot, and its squealing has a tendency to frighten other rats. The trap may be set in a shallow pan or box and covered with bran or oats, care being taken to have the space under the trigger pan free of grain. This may be done by placing a very little cotton under the trigger and setting as lightly as possible. In a narrow run or at the mouth of a burrow, a steel trap unbaited and covered with very light cloth or tissue paper is often effective.

Using Natural Enemies.

Small Irish, Scotch, and fox terriers, when properly trained, may be relied on to keep the farm premises reasonably free of rats.

The average house cat is too well fed and consequently too lazy to undertake the capture of an animal as formidable as the brown rat. Cats that are fearless of rats, however, and have learned to hunt and destroy them, are often

very useful about stables and warehouses. They should be lightly fed, chiefly on milk.

Tame ferrets are inveterate foes of rats, and can follow the rodents into their retreats. Under favorable circumstances they are useful aids to the rat catcher, but their value is greatly over-estimated. For effective work they require experienced handling and the additional services of a dog or two. Dogs and ferrets must be thoroughly accustomed to each other, and the former must be quiet and steady instead of noisy and excitable. The ferret is used only to bolt the rats, which are killed by the dogs. If unmuzzled ferrets are sent into rat retreats, they are apt to make a kill and then lie up after sucking the blood of their victim. Sometimes they remain for hours in the burrows or escape by other exits and are lost. There is danger that these lost ferrets may adapt themselves to wild conditions and become a pest by preying upon poultry and birds.

Among the natural enemies of rats and mice are the larger hawks and owls, skunks, foxes, coyotes, weasels, minks, dogs, cats, and ferrets. Probably the greatest factor in the increase of rats, mice, and other destructive rodents in the United States has been the persistent killing off of the birds and mammals that prey on them. Animals that on the whole are decidedly beneficial, since they subsist upon harmful insects and rodents, are habitually destroyed by some farmers and sportsmen because they occasionally kill a chicken or a game bird, when, as a matter of fact, rats actually destroy more poultry and game, both eggs and young chickens, than all the birds and wild animals combined.

Organized Campaigns.

The necessity of cooperation and organization in the work of rat destruction is of the utmost importance. To destroy all the animals on the premises of a single farmer in a community has little permanent value, since they are soon replaced from nearby farms. If, however, the farmers of an entire township or country unite in efforts to get rid of rats, much more lasting results may be attained. If continued from year to year, such organized efforts are very effective.

Summarizing, the war against rats should be continued by—

(1) Rat-proof construction;
(2) Shielding food supplies;
(3) Protecting natural enemies;
(4) Exhaustive trapping, poisoning, and organized hunts.
(5) Community action.

DIRECTIONS FOR POISONING RATS WITH BARIUM CARBONATE.

General Rules.

Remove so far as practicable all accessible food before setting out poison for rats.

All baits must be fresh and of good quality.

Premises should be inspected each day to remove dead rats and to pick up and destroy uneaten baits.

Trials should be made to find what baits rats will eat at any particular time or place, as they vary their diet according to the season and local conditions. One bait from each of the three following classes should be treated with barium carbonate, thus making up three separate kinds of poisoned bait.

Kinds of Bait.

Meats.—Hamburg steak, sausage, fish, fish offal, crab meat, fresh liver, broken fresh eggs, bacon.

Vegetables and fruits.—Thin slices of cantaloupe, apple, tomato, or cucumber; green corn, cut from cob; mashed banana, boiled carrot, or baked sweet potato.

Other foods.—Toasted bread, cheese, rolled oats, cereals, peanut butter.

Treatment with Barium Carbonate.

Thoroughly mix barium carbonate through the soft baits with the hands or with a spoon in the proportion of one part barium carbonate to four parts of bait. Add water when necessary to make the baits moist.

Sift barum carbonate over the sliced baits and rub it into them with fingers or knife.

Distribution of Prepared Baits.

A teaspoonful, or a small portion, of each of the three separate baits should be set in runways or other places frequented by rats. Set groups of these three baits on strips of paper or board at intervals of 10 to 20 feet.

For any uneaten bait, substitute on the following night another from its class. If none is eaten, substitute an entirely new series. Continue to set poison at frequent intervals until all rats disappear.

To set poison in poultry inclosures.—Over the poisoned bait place a small box with holes of 2-inch diameter at each end, and over the small box place a large box with holes of 2-inch diameter at each side. The bait should be very wet or of such consistency that the rats can not drag it from under the boxes.

Caution.—Keep barium carbonate out of reach of children and irresponsible persons and from domestic animals and fowls.

Antidote for barium carbonate.—Give an emetic of salt, mustard, and warm water followed by Epsom salts or Glauber salts. Call a physician or veterinarian, as the case may require.

DIRECTIONS FOR POISONING RATS WITH STRYCHNINE.

Follow the same general rules and use the same kinds of baits as for poisoning with barium carbonate.

Strychnine is too rapid in action to make its use for rats desirable in houses, but elsewhere it may be used effectively. Strychnine sulphate is the best form to use. The dry crystals may be inserted in small pieces of meat, cheese, fruit, or vegetable baits, and these placed in rat runs or burrows; or oatmeal or other cereals may be moistened with strychnine syrup and small quantities laid in the same way.

Strychnine syrup is prepared as follows: Dissolve ½ ounce of strychnine sulphate in 1 pint of boiling water; add 1 pint of thick sugar syrup and stir thoroughly. A small quantity may be prepared with a proportional quantity of water and syrup. In preparing the baits it is necessary to moisten all the oatmeal with the syrup. Wheat and corn are excellent alternative baits. The grain should be soaked over night in the strychnine.

Antidote for strychnine.—Use an emetic of mustard, followed by large draughts of warm water, and give powdered charcoal. Keep patient in a quiet place, avoiding noise, quick movements, or anything which may startle or disturb. To relieve spasms let patient inhale pure chloroform or give chloral hydrate (25 grains).

DIRECTIONS FOR TRAPPING RATS WITH GUILLOTINE AND CAGE TRAPS.

Rats are often very cunning. It is often difficult to clear them from premises by trapping; if food is abundant, it is nearly impossible. Under favorable conditions, where rat-proofing has made access difficult and the food supply has

been cut off, trapping, if persistently followed, is one of the most effective means of rat control. A common mistake in trapping for rats is to use only one or two traps where dozens are required. For large establishments, such as warehouses, office buildings, and apartment houses, from 20 to several hundred traps may be required; at least 100 traps are required to properly control rats on a medium-sized farm.

Guillotine Trap and Baits.

For general use the improved modern traps with a wire fall, released by a baited trigger and driven by a coiled spring, have marked advantages over the old forms, and many of them may be used at the same time. These traps, sometimes called "guillotine" traps, are of many designs, but the more simply constructed are preferable, and usually more effective than cage traps. Probably those made entirely of metal are best, as they are more durable.*

Remembering that the rat is practically omnivorous, feeding upon all kinds of animal and vegetable matter, baits should be chosen accordingly. Perhaps the most consistent results will be obtained by using baits made from bacon, beef, fish, fresh liver, nut meats, and cheese. Baits should be large, full size of the trigger and secured to it by tying with string or fine wire. The guillotine trap with extended trigger may also be used without bait, upon ledges, narrow rat runs, along the walls, or at the opening of rat burrows. The trigger on all traps should be adjusted to act instantly.

Cage Traps and Baits.

When rats are abundant, large French wire cages may be used to advantage. They should be made of stiff wire, well reinforced. Many of those sold are useless because a full-grown rat can bend the wires and escape.

The baits recommended for guillotine traps may be used in the cage trap. A combination of baits cut in large size can be fastened on a wire hook suspended from the top of the cage on the inside. Pre-baiting is often necessary, allowing the traps to remain open for one or two nights before closing. Twenty-five or more rats have been secured during the night from this procedure. Better results will be secured if traps are covered than if left exposed; an old cloth or bag thrown over the top will be sufficient covering.

Fence and Battue.

This method is applicable at the time of removal of piles of grain, hay, straw, rubbish, and brush. A wire netting or a wooden pen may be used for the inclosure, which should be set up around the pile. The pile of material is then thrown out, allowing dogs and men to get at the rats. Hundreds of rats may be destroyed in this manner in a few hours.

COMMUNITY ORGANIZATION FOR ERADICATING RATS.

Control of rodents is best effected through community cooperation, and organization should be under the direction of a committee representing local civic organizations, such as the Chamber of Commerce, Farm Bureau, Board of Trade, Board of Education, or departmental heads. Communities, both rural and urban, should be divided into precincts, school districts, city block, or group of city blocks, each division to be under the direction of a captain and such assist-

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* Manufacturers of rat traps: J. R. Schuyler & Co., Bloomsburg, Pa.; Animal Trap Co., Lititz, Pa.

ants as are necessary to conduct a complete organization. The aim should be to develop a permanent organization, to be supported by cooperating State and Federal departments. Such campaigns should be outlined to cover a definite period of time and naturally lead up to important repressive measures and more concrete methods of permanent rat control. Campaigns of short duration should not be undertaken.

Funds.

Money for such campaigns should be provided by public subscription, and all should be encouraged to contribute. Such funds should be paid out as prizes rather than bounties, as this will create a friendly rivalry, stimulating contestants to the utmost without quickly exhausting the funds, as in the case of paid bounties. Prizes should be offered for all phases of rat control, such as the greatest number of rats taken, the cleanest district, the greatest number of garbage cans installed, essays by school children on life history, habits, and control of the rat, and for simple rat-proofing work. Funds can be used for the wholesale purchase of traps and poison if desired.

Important Measures to Guide Campaigns.

Important points to strive for in campaigns are cleanliness in markets, stores, warehouses, slaughter houses, alleys, stables, vacant lots, and dwellings, storage in rat-proof containers of waste, garbage, and manure, and prompt removal of the same daily; destruction of old straw or other trash piles, and the wrecking of old sheds, buildings, and walks; piling of lumber, wood, etc., in close stacks at a distance of 18 inches above ground.

Rat-Proofing.

Provisions, grain, and food stuffs should be protected in rat-proof buildings and containers. In rat-proofing granaries, hog pens, poultry houses, dwellings, and stables, quarter-inch steel or wire mesh, sheet metal, or concrete may be used, close attention being paid to ventilation-traps, eaves, and doors, and the lower floors of buildings.

Protection of the Natural Enemies of Rats.

Hawks, owls, and small predatory animals are natural enemies of rats.

Traps.—Where traps are depended upon, a large number should be used, frequently 100 or more to the farm or warehouse. The guillotine type of trap is recommended. Traps should be baited with fresh meat, fish, bacon, sausage, cheese, vegetables, or fruit. Baits should be large and secured by tying to the trigger plate. Traps should be looked at at least three times each day.

The large French cage trap is very good for use in stables, warehouses, and sewers. Pre-baiting should be followed for several nights before closing the trap, using baits of any food material in large quantity suspended by wire from the top of the trap on the inside. Traps should be covered with an old cloth or bag.

Poisons.—Two kinds of poison are used against rats—barium carbonate, in occupied houses or buildings; strychnine (sulphate), for outside work. In the use of poisons care must be exercised to protect children, domestic animals, and fowls. All rats collected for counting should be cremated or buried two feet deep and not thrown into the streets or highways.

[H. P. A.]

SUGAR PRICES FOR THE MONTH

Ended September 15, 1921.

		96° Centrifugals Per Lb.	96° Centrifugals Per Ton.	Beets Per. Lb.	Beets Per Ton.
	(Aug. 16, 1921)	4.8125c	$ 96.25	No quotation.	
[1]	" 17	4.61	92.20		
	" 18	4.50	90.00		
[2]	" 22	4.61	92.20		
	" 25	4.50	90.00		
[3]	" 26	4.625	92.50		
	" 29	4.61	92.20		
[4]	Sept. 2	4.80	96.00		
	" 7	4.5417	90.834		
	" 8	4.375	87.50		
	" 9	4.75	95.00		
	" 13	4.25	85.00		
	" 15	4.00	80.00		

[1] Sale St. Croix.

[2] This sale covers 2200 tons uncontrolled Cubas.

[3] One export sale San Domingos 4.75. Another Porto Ricos. Regular basis domestic sugars 4.50. Cubans holding 4.86.

[4] San Domingos, 30,000 bags.